



II. Part of a Letter from Mr. Anthony Van Leeuwenhoek, F. R. S. concerning the Eyes of Beetles, &c.

I Have formerly spoke of the Multiplicity of Eyes, wherewith the smaller sort of Insects are endued, as Flies are: which Eyes, I have several times shewn to Persons of Quality, that came to see me, to their great Satisfaction; and that in such a manner, that they could clearly discern the shewing of some Hundreds of Eyes at once clearly: Amongst the rest, I have, last Summer, shewn to several English Gentlemen, the Multiplicity of Eyes that are to be seen in the *Tunica Cornea* of a Beetle, that is called the Eye.

This Sight was very strange to the said English Gentlemen; because, that if one will reproach a Man with Blindness, or Dimness of Sight, they use to say in English, *You are as Blind as a Beetle*, because they reckon a Beetle to be Blind.

I have cut that Part of a Beetle, which is reckoned to be his Eye, from the Head, and, after I had made it clean, fixed it before the Magnifying Glass, and observed, that it could not make up half the Bulk of a Globe, it being broader than it was long.

Further, I have told, to the best of my Power, the Eyes that were in One Row, in the greatest Semi-circle, and found that there was, at least, Three Score of them.

Now let us suppose, that in the small Semi-circle of the *Tunica Cornea*, there is but Forty Eyes in One Row, and then add these Sixty to the Forty, and it makes an Hundred, the half whereof is Fifty, which I do imagine, that if we take the *Tunica Cornea* for half a

Globe, they stand in the greater Half-Circuit of the same.

So I have said, with *Metius*, to put before me all the Eyes, wherewith a Beetle is endued, that as Two and Twenty is to Seven, so is the Quadrat Number of the Circle, to the Superficies.

This being so, comes out Three Thousand One Hundred Eighty One Eyes, that are on both the *Tunica Cornea* of a Beetle; if, as I have said heretofore, they both make up a whole Globe.

I have thought good to let a Designer draw a Part of the *Tunica Cornea* of a Beetle, so far as he could follow it by the Help of the Magnifying Glass, partly, to shew the Multitude of Eyes that stand upon it; and chiefly, to shew that every one of them has a Convexity.

But we must not conceive, that every convex Sight of the Beetle, has a Globical Roundness; for if it was so, he could not see the Objects that were somewhat distant from him (I speak here against these that have discovered some Knowledge in the Art of Opticks) but they each of them, a flat kind of Convexity or Roundness.

When I told this to the Designer, he did compare these flat Convexities, to the Buttons we wear in these Days, that are said to be made of Prince *Robert's* Metall.

Fig. 1. A.B.C.D.E.F. doth shew a part of the *Tunica Cornea* of a Beetle.

A B C. doth shew that part of it that is united to the Head of the Beetle.

DEFA. is very near to that part of the great Circle of the Superficies of the *Cornea*, whereon I numbered Sixty Faces or Eyes from DEF to A; and between these Letters we come to see, how each Face or Eye is Elevated into a Roundness.

I know that when we fix any Substance before the Magnifying Glas, that some parts thereof must be nearer to, and others farther distant from the burning Point of the Glas, and these parts that are so, do not shew sharp, but blunt; and therefore when we will see or shew the Heights of the Eyes that are in the *Cornea*, we must put the lower parts of the *Cornea* somewhat farther off from the burning Point of the Magnifying Glas; so that the burning Point, or Sight of the Magnifying Glas, may reach these that are in the *Cornea*, as we must do with Two or more grounded Glasses, fixed in a Box; and this being so, we should have an Hundred Objects of the Eyes that are in the *Cornea*, seen at once, but yet very small; for the Steeple of our new Church, whose Distance is great, as I have related in my former Letters, seem, through the Eyes of the Beetle, no bigger to me than the Point of a small Needle.

Here we see now, how these are mistaken, that take the Beetle to be blind, and how sufficiently this small Animal is provided with Sight, not to speak of the other Parts of his Body; which Insect, when we meet it, we tread under our Feet, as having no esteem for so Black a Creature.

In the Month of *August*, in the Year last past, I saw a Fly creeping on the Windows of the back Part of my House, which was of the Bigness of a Bee; which sort of Flies (yet very few of them) I have observed there to come every Year.

The Paws of these Flies, chiefly that Side they run withal, are plentifully provided with Hair-like Parts, wherewith they know to run upon Polished Glas, more than any other sort of Flies. I have cut off Paws, and fixed them before the Magnifying Glas, for to shew the

Tools wherewith they are able to fix themselves to the Polished Glafs, and fo to run up.

I have alfo cut off the *Cornea* of the Head of thefe Flies, and have obferved that it was befet with very many fmall Hairs, which were placed not upon the Eyes, but between them.

Further, I have taken the Matter that fills up the *Cornea* out of it, to judge of it by the Help of the Magnifying Glafs, and that the rather, becaufe I could never before fatisfy my felf about it, *viz.* to what Purpose this Stuff was made; and I did conclude, that this Matter was confifting of a Subftance like unto a Thread.

When I had fpread a little afunder, the mentioned Matter, that I might obferve it with more Attention, than I had yet done before; I faw, that all this Stuff, which I had judged to be a Thread, was very near altogether of the fame Length, and that one End was fomewhat thicker than the other, and roundifh on the thicker End.

By thefe accurate Obfervations, and near Confiderations, which I often repeated one after the other, I did affure my felf, that this great Number of fmall Parts, which I faw there, was each of them a Nerve of an Eye, and that the thick and round End of it had been placed in the Hollownefs of the *Cornea*: In fhort, as many Sights as are in the *Cornea*, fo many there is of Nerves.

The Reafon why One End of the Nerves of the Eyes that goeth inwards towards the Head, is thinner, as I have faid before, muft neceffarily be, becaufe the *Cornea* has a roundifh Bulkinefs, and therefore the Sinews muft be the thinner, the farther they go in; for the room grows lefs than it is, by the Hollownefs of the *Cornea*, and who doth know whether, that Part where the Optick Nerves do end, be not the Brain? which muft be inquired after.

I have, to give the more Satisfaction, laid some Nerves of the Eyes, which I had taken out of the beforementioned Fly, upon Glafs, last Year, and fixed it before the Magnifying Glafs, to have it delineated, as well as the Designer could follow it.

Fig. 2. G H, are Two Optick Nerves, H being placed very near, or quite in the Hollowness of the Sight, and G was placed inwards, toward the Head of the Fly.

Fig. 3. I K L, are Seven Optick Nerves, the thickest End whereof was also placed towards the *Cornea*.

Fig. 4. M N O P Q, shewed a great Number of the Optick Nerves, that lye one upon the other, whereof the upermost Ends, as N O P, were also placed to the *Cornea*; and because there lie so many one upon another, one cannot discern the true Length of them, and where they lay somewhat thick, the Light can conveniently be discerned, for they are somewhat transparent, as is shewed in the last named Figure.

I have formerly shewed, how every thin part of Flesh, or Fish, when it doth lie in Rest, is full of Wrinkles, or else full of Rings like Joints, but when they are brought out of Rest, and are employed, the Wrinkles and Rings are gone, and the Parts grow longer.

These Ring-like Wrinkles I have also observed or discovered in the Optick Nerves of the said Fly, from whence we may well conclude, that each of these small Optick Nerves, are as well provided with Extension, as the Nerves of our Eyes; for we cannot move our Eyes from one side to the other, but the Nerves of our Eyes must be more extended than if we see out Straight.

When

When I had discerned these, I asked the Designer, Whether he could see these Ring-like Stripes, in the Optick Nerves? and when he said he could see them clearly, I charged him to follow them as much as was Possible, as you may see in *Fig. 2. and 3.*

Yet if the Fly had been Dead for some while, when I had taken out the Nerve of the Sight, I could have observed none of this Wrinkling; as we daily see, that the Muscles of a Fish that has been dead for a good while, do not contract themselves when they are cut in Pieces, which we call Krimping; and in this Case, the Parts of the Fish are not so hard, nor so well tasted, as they would have been, if they had been cut before they were quite dead.

Having discovered these wonderful Things and Perfections of the Eye of a Fly, we must say again, how little it is we know, and if this is so in a great Fly, it must be the same in a less one.

Further, I have since, a few Days ago, taken out of common Flies Eyes, the Optick Nerves, and have lookt upon them several times. because I had great Pleasure to see them in so neat an Order, and finding them, where they do not lie too close together, of the Colour of Red Lead.

I did, when the Designer was busy to make the fore-mentioned Draught, catch a small Gnat, of that sort that do not afflict Men, because they are no Blood-Suckers, nor have no Sting.

I cut off the Head of this, to draw out of the Eyes or Sights, the Optick Nerves; but I could not shew them clear enough before my Eyes, although I did attempt it three or four times; in which Undertaking, I took several times the Nerves of the Eye, surrounded with a vast Number of Vessels, which I was sure to be Veins; and I
could

could not accomplish to pull these Nerves out of the Head, without breaking them and the Veins, until at length it did happen, that I did pull them out of the Head of the Gnat, without breaking off either of them, which, put before the Magnifying Glass, I gave to the Designer to draw, and that the rather, because a Gentleman of Quality did tell me, that a certain Person, when they came to speak of my Dissecting, did often object, That it was impossible to do what I did affirm, because the Instruments I was to use for that purpose, how small soever I could make them, could not be fit to make these Dissections I did relate: But I do not matter these Objectors, perhaps it is one of them, that doth wish he could do the same.

Fig. 5. R. S. T. sheweth the Nerves of the before-mentioned Gnat, as well as the Designer could delineate them, he oftentimes repeating, That it was impossible to delineate all the Vessels he did see.

I have also, not only taken out of the Paws of the before-said Gnat, the Flethy Muscles, to my full Satisfaction, but also the Two Pullers that are between each Joint of the Paw, whereof one doth extend, and the other contract the Joints; and this is no Labour for me. But I conclude and remain,

Delft, May 9.

1698.

T O U R's, &c.